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(54) Title of the Invention: Fluid Transfer Pump
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Specification

1. Title of the Invention

Fluid Transfer Pump

2. Claims

(1) A fluid transfer pump that transfers fluid at a specified pressure, the pump characterized by a pump housing and motor, wherein a fluid passageway is provided within the rotors that make up said motor, and in addition, a stator for said motor is formed through the use of at least two separable portions.

(2) A fluid transfer pump as claimed in Claim 1, wherein at least two separable stator portions are connected in a freely swinging fashion through the use of a connecting member.

(3) A fluid transfer pump as claimed in Claims 1 and 2, which is a centrifugal pump in which fluid is circulated within the pump housing through the use of an impeller gear that rotates under the driving action of a motor, and centrifugal force is used to transfer said fluid.

(4) A fluid transfer pump as claimed in Claims 1 and 2, which is an axial-flow pump in which fluid is transferred within the pump housing in the direction of the rotating axis of an impeller member through the use of said impeller member, which rotates under the driving action of a rotating drive source.

(5) A fluid transfer pump as claimed in any one of Claims 1 through 4, in which said pump is used for the transfer of blood.

Detailed Explanation of the Invention

<Technical Field>

This invention pertains to a fluid transfer pump that is suitably utilized at times when cannulation is conducted, and more specifically, this invention is composed of a pump housing and a motor used to drive said pump housing. In essence, the stator of the aforementioned motor is constructed of at least two separable portions, and therefore it is possible to easily remove a

rotor that is surrounded by its given stator portion by separating the stators from one another.

<Background of the Invention>

Previously, a form of fluid transfer pump that has been widely accepted is one in which the pump housing and motor are combined as a unit, such that the fluid transfer operation is conducted through the rotation of the impeller, which makes up the pump housing portion and is driven by the force of the aforementioned motor. Actually, the aforementioned motor is basically constructed of a rotor that is supported on the inside in a freely rotating fashion, along with a stator that surrounds the outside of the rotor. In the case of an axial-flow pump, the center shaft of the aforementioned rotor is equipped with a fluid passageway.

However, in recent years, fluid transfer pumps are increasingly being used for medical treatments in blood circulation systems that operate outside the body. In these cases, the stator and rotor portions of the motor that make up the aforementioned fluid transfer pump are combined as a unit. Due to this single-body construction, it has been pointed out in the case of blood circulation systems that utilize a fluid transfer pump and are operated outside the body that the operation of equipping a patient with this type of pump is complicated. That is to say, in cases where the aforementioned blood circulation systems are constructed, a blood transfer tube is first attached to the aforementioned fluid transfer pump, and this tube is then inserted into the vein of the patient. In this case, all the parts that come into direct contact with the blood have to be discarded after each use. It is also widely known that the motors used in the construction of the aforementioned axial-flow type fluid transfer pumps are considerably heavy, particularly with respect to the stator portion. Accordingly, with the fluid tube connected to another unit as it is, this makes it practically impossible to interchange the motor housing that makes up the parts that

come into contact with the blood given the fact that the aforementioned stator and rotor portions are constructed as a single unit. Furthermore, this situation is less than favorable for the patient even under the best of conditions.

On one hand, even though a centrifugal type blood pump contains a passageway for the blood that passes through the inside of the motor, even in this case the parts that make direct contact with the blood must be discarded after each patient has used them. As such, once the blood tube has been sent through the stator portion that makes up the motor in the case where the rotor and stator are combined into a single unit, it is then necessary to insert a cannula into the vein of the patient. As a result, the relatively heavy stator portion that is suspended from the blood circuit makes for a similarly unfavorable situation for the patient.

<Objective of the Invention>

The objective of this invention is to provide a fluid transfer pump, wherein: the aforementioned inconveniences can be avoided; the device comprises a pump housing and a motor; said fluid transfer pump is designed such that a passageway for liquid runs through the inside of the aforementioned motor; the stator portion that is arranged along the outside of said motor is formed in pieces so that it can be separated, and accordingly, this type of construction allows for free assembly and disassembly of the pump housing as well as the rotor portion of the motor with respect to the aforementioned stator portion; there is no undue burden placed on the patient as a result of assembling the aforementioned liquid circuit or equipping the patient with said device; and the rotors, etc., which comprise the parts that come into direct contact with blood can be easily interchanged.

<Means for Achieving the Objective>

In order to achieve the objective stated above, this invention provides a fluid transfer pump that transfers fluid at a specified pressure, the pump characterized by a pump housing and motor, wherein a fluid passageway is provided within the rotors that make up said motor, and in addition, a stator for said motor is formed through the use of at least two separable portions.

<Embodiment Forms>

In this section, suitable embodiment forms will be provided for the fluid transfer pump related to this invention, and the following detailed explanation will be based on the attached drawings used as reference materials.

In Figure 1, reference symbol 10 indicates a blood circulation system that operates outside the body and which includes a fluid transfer pump related to this invention. Said blood circulation system 10 is basically composed of tubes 14 and 16, which are connected to the veins of the patient 12, along with a liquid transfer pump 18, to which the aforementioned tubes 14 and 16 are also connected, and a servo amp 20. In this case, the aforementioned servo amp 20 is connected to the aforementioned liquid transfer pump 18 via a cable 22, and also connected to this servo amp 20 are one end of two cables 24 and 26. The other ends of these two cables 24 and 26 are respectively connected to a pressure measurement device and a hydrometer (neither of which are shown in the drawing) that are adjacent to the tube 16. The blood pressure and flow rate that are measured through this arrangement are converted into signals and sent to the aforementioned servo amp 20.

Next, as shown in Figures 2 through 4, the aforementioned liquid transfer pump 18 is composed of a motor 28 and a pump housing 30. This motor 28 includes a stator unit 32, which is located to the outside, and a rotor unit 34, which is located inside the stator unit 32 and is also secured to the pump housing 30. The aforementioned stator unit 32 includes stator cases 36a and 36b that take on the form of a barrel, and these stator cases 36a and 36b are linked to one another in a freely opening and closing fashion through the use of hinges 38a and 38b that are installed onto the outer wall surface (see Figure 3). In this case, the aforementioned stator cases 36a and 36b swing in directions approaching each other, and when the other ends make contact with one another said stator cases 36a and 36b take on the form of a barrel. In addition, the fasteners 40a and 40b that are attached to these end portions are used to prevent these stator cases 36a and 36b from becoming separated.

As shown in Figure 4, semicircular dugout portions 42a and 42b are formed along each of the inner wall surfaces of the aforementioned stator cases 36a and 36b, and linked armatures 44a and 44b are anchored to these dugout portions 42a and 42b as part of the stator portion. In addition, a substrate 46 is attached to the aforementioned stator case 36b, and attached to this substrate 46 is an electromagnetic sensor 48 that is used to detect the rotation speed of the rotor (discussed below). An electrical connection is made between the substrate 46 and the servo amp 20 via the cable 22 noted above.

Next, a rotor unit 34 is installed within the aforementioned stator unit 32, which is to say that this rotor unit 34 is enclosed by the housing 50. Note that a shell 51 is secured to one end of this housing 50 as a unit, and this shell 51 is equipped with a liquid introduction port 51a. A

threaded portion is formed along one part of this shell 51, and a nut 53 is screwed onto this threaded portion. A rotor 52 is supported within the aforementioned housing 50 in a freely rotating fashion through the use of a bearing 49, etc. In this case, multiple motor magnetos 54 are installed onto the aforementioned rotor 52 as rotating members that correspond to the armatures 44a and 44b, which are respectively attached to the aforementioned stator cases 36a and 36b. In addition, a magneto 56 is installed onto the member that corresponds to the electromagnetic sensor 48, which is installed onto the stator case 36b.

In addition, the aforementioned rotor 52 is equipped with a passageway 58 that passes through in the axial direction of said rotor. One end of this passageway 58 communicates with a fluid introduction port 51a that is formed by the casing 51, which is installed as a unit in the aforementioned housing 50. The other end of this passageway 58 communicates with the pump housing 30.

In other words, the aforementioned pump housing 30 includes a housing 60 that is secured as a single unit to the aforementioned housing 50 and is linked to the aforementioned rotor 52 within this housing 60. In addition, an impeller 62 is installed that rotates along with the rotation of said rotor 52 during the rotation operation. In this case, this impeller 62 is constructed from a disc-shaped side plate 64, along with several impeller members 65 that are attached to said side plate 64 and are curved in a radial pattern with respect to the rotating axis of the aforementioned rotor 52.

In addition, a lid member 66 is attached to the side surface of the aforementioned housing 60, and a pin member 68 is installed in the center of this lid member 66. This pin member 68 makes direct contact with the center of the side plate 64 of the aforementioned impeller 62 and

supports this [the side plate 64] in a freely rotating fashion. Furthermore, a shell 72 that is equipped with a fluid derivation port 70, which communicates through the internal portion, is attached to the peripheral surface of the aforementioned housing 60. In this case, the tube 16 noted above is connected to the aforementioned shell 72.

The fluid transfer pump related to this invention is basically constructed according to the description provided above, and the following explanations pertain to its operation as well as the results of the invention.

First of all, one end of the tubes 14 and 16 that make up the blood circulation system 10 that operates outside the body is respectively connected to the shells 51 and 72 of the fluid transfer pump 18. Then, the other ends of these tubes 14 and 16 are connected to other specified locations such as the veins of the patient 12. At this time, the stator unit 32 that comprises the aforementioned fluid transfer pump 18 is removed from the rotor unit 34 and the pump housing 30. In other words, while the nut 53 that is screwed onto one end of the aforementioned rotor unit 34 is turned in a specified direction in order to be loosened, the fasteners 40a and 40b that connect the stator cases 36a and 36b, which comprise the aforementioned stator unit 32, are released.

As a result, it becomes possible to create an opening for the aforementioned stator cases 36a and 36b with the hinges 38a and 38b at the center, both of which are attached to one end of the stator cases 36a and 36b. Accordingly, once the stator cases 36a and 36b have been swung in the direction to separate them from one another, they can be removed from the rotor unit 34 and the pump housing 30. As such, with the relatively heavy stator unit 32 separated from the rotor unit 34 and the pump housing 30, it is possible to equip the patient 12 with the aforementioned tubes 14 and 16, thus providing for simple handling of the fluid transfer pump 18 and making it possible to conduct an easy and reliable installation of these tubes 14 and 16.

Then, once the installation has been conducted for the tubes 14 and 16 as explained above, the stator unit 32 for the fluid transfer pump 18 is installed onto the rotor unit 34 as well as the pump housing 30. In other words, with the stator cases 36a and 36b, which comprise the aforementioned stator unit 32, swung in the open direction, either of the stator cases 36a or 36b, for example stator case 36a, can be connected to the housing 50 of the rotor unit 34, and then the other stator case 36b can be swung in a direction approaching the aforementioned stator case 36a. As a result, the rotor unit 34 becomes enclosed by the aforementioned stator cases 36a and 36b. Next, while the nut 53 that is screwed onto the aforementioned rotor unit 34 is turned in the tightening direction, the fasteners 40a and 40b lock the aforementioned stator cases 36a and 36b into place.

Given the above operation, the patient 12 can be equipped with said blood circulation system 10 that operates outside the body, and then once an output signal is derived for the control of the revolution speed of the motor 28 by means of the servo amp 20, the resulting

electrical signal will travel through the cable 22 to drive the fluid transfer pump 18. In other words, this electrical signal that is sent from the aforementioned servo amp 20 via the cable 22 is delivered to the armatures 44a and 44b that are installed within the stator cases 36a and 36b. Thus, the rotor 52 that is installed within the housing 50 of the rotor unit 34 in a freely rotating fashion begins to rotate under the operation of the aforementioned armatures 44a and 44b as well as the motor magneto 54. Along with this, the impeller 62 that is installed within the pump housing 30 rotates in its specified direction. In this case, the blood of the patient 12 is delivered to the aforementioned pump housing via the tube 14, the shell 51 and the passageway 58 that is formed within the rotor 52. Accordingly, this blood is sent out to the tube 16 via the fluid derivation port 70 by means of the centrifugal force that is generated within the housing 60 under the rotating operation of the aforementioned impeller 62, finally resulting in delivery of the blood from the tube 16 to the patient 12. At this point, measurements are taken of the pressure of the blood as it is delivered through said tube 16 as well as the blood flow using a pressure measurement device and a hydrometer (neither of which are shown in the drawing), after which these measurements are sent via cables 24 and 26 to the servo amp where they are also displayed.

Next, an explanation will be provided of another embodiment form of this fluid transfer pump. Note that in this embodiment, the same reference symbols are used to indicate the same structural components that were covered in Embodiment No. 1, and thus detailed explanations of these components have been omitted.

To be precise, as shown in Figure 5, the fluid transfer pump 80 that relates to this embodiment form is equipped with a passageway 82 that not only travels in the axial direction through the center of a rotor 52 that comprises the motor 28, but also has an intermediate

member with an expanded diameter. Also, a pump housing 84 is installed within this passageway 82, and said pump housing 84 includes a multiple number of impeller members 86 that are arranged within the expanded portion of said passageway 82, such that these impeller members 86 are directed toward the central portion of this passageway 82. Note that the end portion is attached to a shaft 88 and that the impeller members 86 are attached to the rotor 52 at a slight angle with respect to the axial direction of the passageway 82.

Given this type of construction, once the rotor 52 is rotated in the specified direction under the driving action of the aforementioned motor 28, the blood of the patient 12 that is fed from the shell portion 19 is delivered to the patient 12 by means of the aforementioned impeller 86. Moreover, in the same fashion as the stator cases 36a and 36b, which are discussed in Embodiment No. 1 and comprise the stator unit 32, the fluid transfer pump 80 that relates to this embodiment is manufactured as a separable unit, and for this purpose, when said fluid transfer pump 80 is included as part of the blood circulation system 10 that operates outside the body, the process of equipping the patient with the tubes 14 and 16 for this blood circulation system 10 can be easily conducted.

<Effect of the Invention>

As noted above, this invention calls for a liquid transfer pump in which the pump housing and rotational drive source are constructed as a unit and in which a passageway for the fluid is formed within this rotational drive source. In addition, the stator portion of this rotational drive source is to be constructed in order to allow it to be separated into at least two parts, such that said stator portion can be easily removed from the pump housing as well as the rotor portion of the rotational drive source. As a result, when the liquid circuit is assembled to include the pump used for transferring said liquid, it becomes possible to conduct the operation with the stator portion removed from the aforementioned rotational drive source. Accordingly, this makes it possible to conduct the assembly operation itself given a liquid transfer pump with a reasonably lightweight construction, thus finally achieving a situation in which this type of operation can be conducted both easily and accurately. Moreover, in cases where damage occurs to the rotation speed detection circuit or the armatures that are assembled in correspondence with the aforementioned stator portion, there is no need to remove the entire liquid transfer pump itself from the liquid circuit, and by removing only the stator portion, it becomes possible to repair the armatures as well as the rotation detector circuit, etc. As a result, an effect is achieved by which maintenance conducted on the flow transfer pump can be simplified.

While appropriate embodiment forms have been presented above for the purpose of explaining this invention, the invention is not limited to these embodiment forms, and thus it is naturally possible to make various improvements or design modifications within limits, as long as they do not deviate from the essential points of this invention.

4. Brief Explanation of the Drawings

Figure 1 is a schematic drawing that explains a blood circulation system that operates outside the body and which includes a fluid transfer pump related to this invention.

Figure 2 is an oblique schematic drawing of a partially disassembled fluid transfer pump related to this invention.

Figure 3 is a partial side view of the fluid transfer pump shown in Figure 2.

Figure 4 is a partial cross section that explains the fluid transfer pump shown in Figures 2 and 3.

Figure 5 is a partial cross section that illustrates another embodiment form of the fluid transfer pump related to this invention.

10: Blood circulation system that operates outside the body

18: Fluid transfer pump

20: Servo amp

28: Motor

30: Pump housing

32: Stator unit

34: Rotor unit

36a, 36b: Stator cases

44a, 44b: Armatures

52: Rotor

54: Motor magneto

62: Impeller

Patent Applicant: Terumo Corporation

Agent to Applicant: Masahiro[?] Chiba, Patent Attorney [seal]

FIG.1

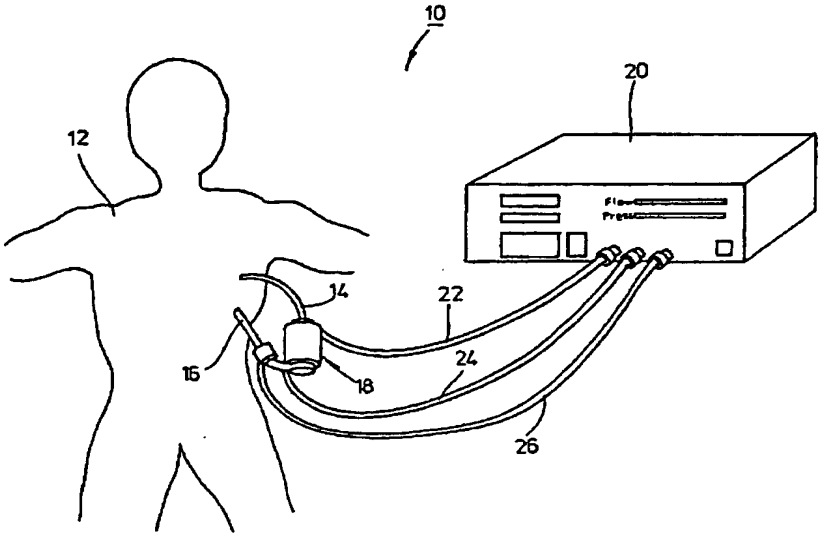

10
12
20
14
22
16
18
24
26

FIG.2

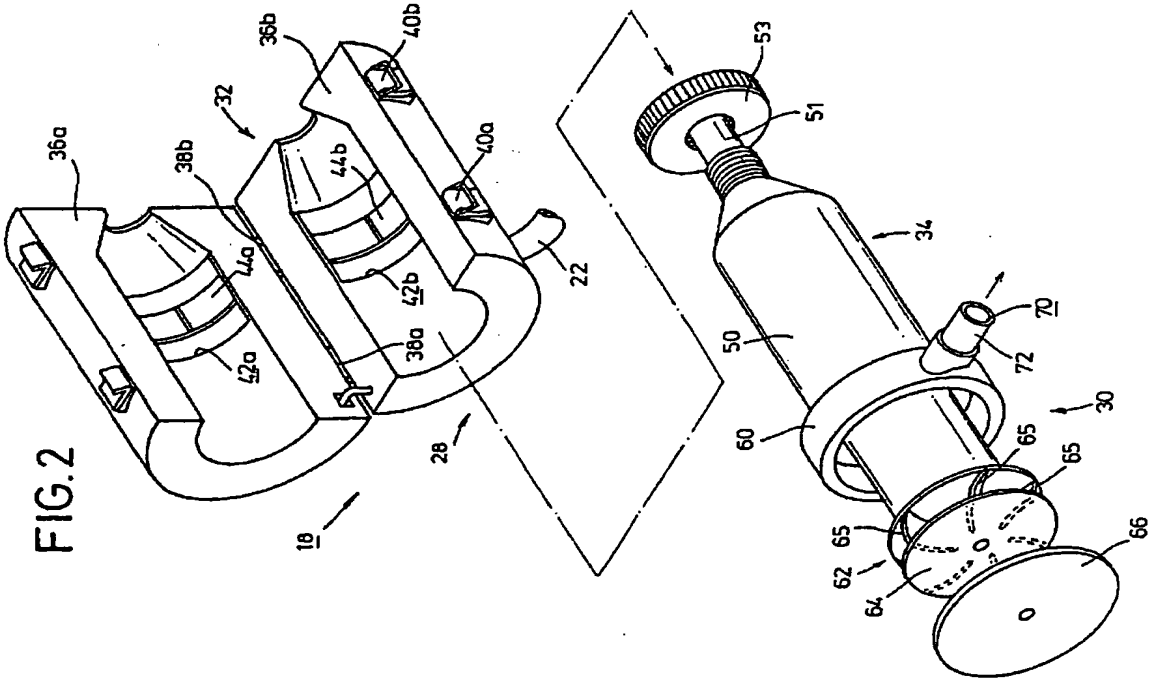
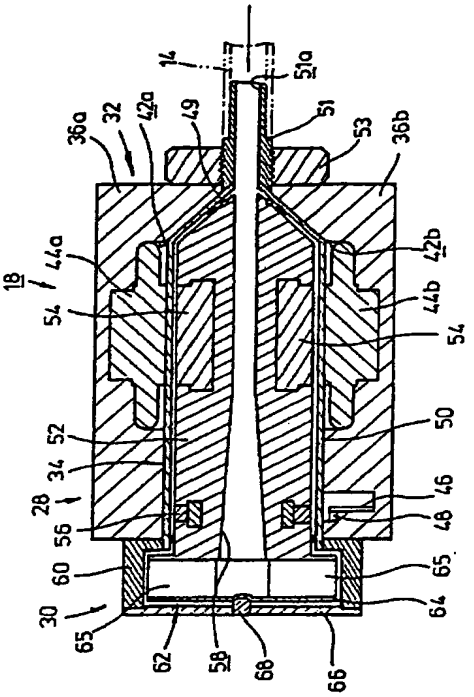

36b
40b
32
36a
38b
44b
40a
44a
42b
22
42a
38a
28
18
53
51
34
70
72
50
30
60
65
65
65
66
62
64

FIG.4


14
7
50a
36a
32
42a
49
51
53
36b
18
44a
42b
54
44b
54
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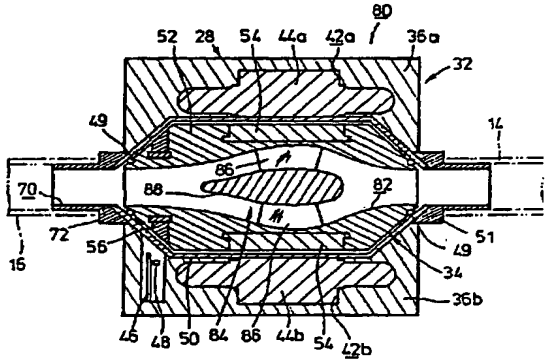
65
30
64
65
62
58
68
66

FIG.5


80
52
28
54
44a
42a
36a
32
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14
86
70
88
82
72
56
51
49
16
34
36b
46
48
50
84
86
44b
54
42b

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⑤④発明の名称　流体移送ポンプ

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㉒出　願　昭62(1987)9月14日

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明　細　書

1. 発明の名称

流体移送ポンプ

2. 特許請求の範囲

(1) 流体を所定の圧力で移送する流体移送ポンプであって、ポンプ本体と、モータとからなり、前記モータを構成する回転子に流体用通路を画成すると共に、前記モータの固定子を分離可能な少なくとも2以上の部分から形成したことを特徴とする流体移送ポンプ。

(2) 特許請求の範囲第1項記載のポンプにおいて、分離される少なくとも2つの固定子部分を連結部材を介して揺動自在に連結してなる流体移送ポンプ。

(3) 特許請求の範囲第1項または第2項記載のポンプにおいて、ポンプ本体はモータの駆動作用下に回転する羽根車を介して流体を回転させ、その遠心力を利用して当該流体を移送する遠心ポンプであることからなる流体移送ポンプ。

(4) 特許請求の範囲第1項または第2項記載のポンプにおいて、ポンプ本体は回転駆動源の駆動作用下に回転する羽根部材を介して流体を前記羽根部材の回転軸方向に移送する軸流ポンプであることからなる流体移送ポンプ。

(5) 特許請求の範囲第1項乃至第4項のいずれかに記載のポンプにおいて、ポンプは血液移送用のポンプであることからなる流体移送ポンプ。

3. 発明の詳細な説明

［産業上の利用分野］

本発明はカニュレーション等を行う際に好適に用いられる流体移送ポンプに関し、一層詳細にはポンプ本体と当該ポンプ本体を駆動するためのモータとからなり、前記モータの固定子を実質的に少なくとも2以上に分離可能に構成し、従って、夫々の固定子を互いに離間させることによりこの固定子に囲繞されていた回転子を容易に取り出すことを可能とする流体移送ポンプに関する。

［発明の背景］

従来から、ポンプ本体とモータとを一体的に組み込んで前記モータの駆動作用下にポンプ本体を構成する羽根車を回転させることにより流体の移送を行う流体移送ポンプが広汎に採用されている。実際、前記モータは内部側に回転自在に支承される回転子と、この回転子を外側から囲繞する固定子とから基本的に構成される。軸流型ポンプでは前記回転子の中心軸に流体用通路が画成される。

ところで、近年、流体移送ポンプが医療用として血液の体外循環システム等に使用されつつある。この場合、前記流体移送ポンプを構成するモータの固定子と回転子とは一体的に組み込まれている。このような一体構成のために、流体移送ポンプを用いた血液の体外循環システムにおいて、このポンプを患者に装着する作業が煩雑であるとの指摘が従来から存在している。すなわち、前記血液の体外循環システムを組み立てる際には、先ず、前記流体移送用ポンプに血液移送用チューブを接続し、次いで、前記チューブを患者の血管等に接続することになる。この場合、血液接触部位は患者毎に使い捨てする必要がある。周知の通り、軸流型ポンプとしての前記流体移送ポンプを構成するモータの中、特に、固定子は相当に重量が大きい。従って、流体の管路を他のユニットと接続したままで血液接触部位を構成するモータ本体を交換することは、前記のように固定子と回転子とが一体化した構成のものでは実際上不可能であり、また、敢えて行ったとしても、患者等にとって好ましいことではない。

一方、遠心型血液ポンプでモータ内を血液用流路が貫通するものがあるが、この場合も患者毎に血液接触部を使い捨てしなければならない。その際、回転子と固定子とが一体化されたものではモータを構成する固定子内に一旦血液チューブを通し、次いで、患者側の血管へカニューラを挿入しなければならず、この結果、比較的重量のある固定子を血液回路に懸吊した状態となり、同様に患者にとって好ましいものではない。

［発明の目的］

本発明は前記の不都合を克服するためになされたものであって、ポンプ本体とモータとからなり、しかも前記モータの内部に流体用通路を画成した流体移送ポンプにおいて、前記モータを構成し且つ当該モータの外部側に配設される固定子を相互に離間可能な分離構造にし、これによってポンプ本体並びにモータの回転子を前記固定子に対して着脱自在となるよう構成し、前記流体回路の組立並びに患者等に装着された後でも患者に負担にならず、また、血液接触部位を構成する回転子等の交換も容易な流体移送ポンプを提供することを目的とする。

［目的を達成するための手段］

前記の目的を達成するために、本発明は流体を所定の圧力で移送する流体移送ポンプであって、ポンプ本体と、モータとからなり、前記モータを構成する回転子に流体用通路を画成すると共に、前記モータの固定子を分離可能な少なくとも２以上の部分から形成したことを特徴とする。

［実施態様］

次に、本発明に係る流体移送ポンプについて好適な実施態様を挙げ、添付の図面を参照しながら以下詳細に説明する。

第１図において、参照符号10は本発明に係る流体移送ポンプを組み込む血液の体外循環システムを示し、当該血液の体外循環システム10は患者12の血管に接続されるチューブ14、16と、前記チューブ14、16が接続される流体移送ポンプ18と、サーボアンプ20とから基本的に構成される。この場合、前記サーボアンプ20はケーブル22を介して前記流体移送ポンプ18と接続すると共に、当該サーボアンプ20にはケーブル24、26の一端側が接続される。前記ケーブル24、26の他端側は夫々チューブ16側に配設される図示しない圧力測定器、流量測定器に接続されてこれらにより測定された血液の圧力並びに流量を

信号化して前記サーボアンプ20に送給している。

そこで、第2図乃至第4図に示すように、前記流体移送ポンプ18はモータ28とポンプ本体30とから構成されており、前記モータ28は外部側に配設される固定子ユニット32と前記固定子ユニット32の内部に配設され且つ前記ポンプ本体30に固着される回転子ユニット34とを含む。前記固定子ユニット32は略半円筒状を呈する固定子枠体36a、36bを含み、前記固定子枠体36aと36bとはその外壁面部に取着される蝶番38a、38bを介して開閉自在に係合している（第3図参照）。この場合、前記固定子枠体36aと36bとは互いに接近する方向に揺動し、その他端側が互いに当接した際には当該固定子枠体36aと36bとにより略円筒状を形成すると共に、その他端側に取着される止め金具40a、40bにより当該固定子枠体36a、36bの相互の離脱が阻止されるよう構成している。

第4図に示すように、前記固定子枠体36aと36bの内壁面には夫々半環状の凹部42a、42bが画成され、当該凹部42a、42bには固定子としての電機子44a、44bが係合固着されている。さらに、前記固定子枠体36bには基板46が取着され、当該基板46には後述するロータの回転速度を検出する磁気センサ48が取着されている。前記基板46は前述したケーブル22を介してサーボアンプ20と電気的に接続されている。

次に、前記固定子ユニット32内に回転子ユニット34を配設する。すなわち、前記回転子ユニット34はハウジング50に囲繞され、なお、当該ハウジング50の一端側には管体51が一体的に固着されると共に、この管体51により流体導入口51aが画成される。前記管体51の一部にはねじ部が形成され、このねじ部にナット部材53が螺合する。前記ハウジング50の内部にはロータ52が軸受49等を介して回動自在に支持される。この場合、前記ロータ52には前記固定子枠体36a、36bに取着される電機子44a、44bに対応する部位に回転子としての複数のモータマグネット54が取着されると共に、固定子枠体36bに配設される磁気センサ48に対応する部位にはマグネット56が取着されている。

さらに、前記ロータ52にはその軸線方向に貫通する通路58が画成されており、当該通路58の一端側は前記ハウジング50に一体的に取着される管体51により形成される流体導入口51aと連通している。一方、前記通路58の他端側はポンプ本体30に連通している。

すなわち、前記ポンプ本体30は前記ハウジング50に一体的に固着されるハウジング60を含み、前記ハウジング60内には前記ロータ52と係合し且つその回転作用下に当該ロータ52の回転に伴って回転する羽根車62が配設される。この場合、前記羽根車62は円盤状の側板64と、この側板64に取着され且つ前記ロータ52の回転軸に対して放射状に湾曲して複数枚設けられる羽根部材65とから一体的に構成されている。

さらに、前記ハウジング60の側面部には蓋部材66が取着されており、当該蓋部材66の略中央部にはピン部材68が設けられる。前記ピン部材68は前記羽根車62の側板64の略中央部に当接してこれを回動自在に支持する。さらにまた、前記ハウジング60の外周面部にはその内部と連通する流体導出口70を画成する管体72が取着されている。この場合、前記管体72には前述したチューブ16が接続されることになる。

本発明に係る流体移送ポンプは基本的には以上のように構成されるものであり、次にその作用並びに効果について説明する。

先ず、血液の体外循環システム10を構成するチューブ14、16の一端側を流体移送ポンプ18の管体51、72に夫々接続する。次いで、前記チューブ14、16の他端側を患者12の血管等所定の部位に接続する。その際、前記流体移送ポンプ18を構成する固定子ユニット32を回転子ユニット34並びにポンプ本体30から取り外しておく。すなわち、前記回転子ユニット34の一端側に螺合するナット部材53を所定方向に回動させて弛緩すると共に、前記固定子ユニット32を構成する固定子枠体36a、36bを連結している止め金具

40a、40bを解放する。この結果、前記固定子枠体36a、36bはその一端側に取着される螺番38a、38bを中心として開成可能となる。従って、前記固定子枠体36a、36bを互いに離間する方向に揺動させた後にこれを回転子ユニット34並びにポンプ本体30から取り外せばよい。このように、比較的大きい重量を有する固定子ユニット32を回転子ユニット34並びにポンプ本体30と離脱した状態で前記チューブ14、16を患者12に対して装着出来るため、当該流体移送ポンプ18の取り扱いが容易となり、前記チューブ14、16の装着作業を容易且つ確実に行うことが出来る。

そこで、前記のように、チューブ14、16の装着作業を行った後に流体移送ポンプ18の固定子ユニット32を回転子ユニット34並びにポンプ本体30に装着する。すなわち、前記固定子ユニット32を構成する固定子枠体36a、36bを開成する方向に揺動させた状態で当該固定子枠体36a、36bのいずれか一方、例えば、固定子枠体36aを回転子ユニット34のハウジング50に係合させ、次いで、他方の固定子枠体36bを前記固定子枠体36aに接近する方向に揺動させる。この結果、前記固定子枠体36a、36bにより回転子ユニット34が囲繞された状態となる。次いで、前記回転子ユニット34に螺合するナット部材53を回動させて緊締すると共に、止め金具40a、40bにより前記固定子枠体36a、36bをロック状態とする。

以上の作業で患者12に対して当該血液の体外循環システム10が装着され、次いで、サーボアンプ20によりモータ28の回転速度等を制御する出力信号を導出してその電気信号によりケーブル22を介して流体移送ポンプ18を駆動する。すなわち、前記サーボアンプ20からケーブル22を介して送給された前記電気信号は固定子枠体36a、36bに取着される電機子44a、44bに送給される。これによって回転子ユニット34のハウジング50内に回動自在に配設されるロータ52が前記電機子44a、44bとモータマグネット54の作用下に回転を開始し、これに伴ってポンプ本体30に配設される羽根車62が所定方向に回転する。この場合、前記ポンプ本体30にはチューブ14、管体51並びにロータ52内に形成される通路58を介して患者12の血液が送給されている。従って、前記羽根車62の回転作用下にこの血液がハウジング60内においてその遠心力により流体導出口70を介してチューブ16へと吐出され、結局、当該チューブ16から患者12に送給されるに至る。その際、前記チューブ16内において送給される血液の圧力並びに流量を図示しない圧力測定器および流量測定器により測定してケーブル24、26を介してサーボアンプ20に送給しこれを表示する。

次に、当該流体移送ポンプの他の実施態様について説明する。なお、この実施態様において前述した第1の実施態様と同一の構成要素には同一の参照符号を付し、その詳細な説明を省略する。

すなわち、この実施態様に係る流体移送ポンプ80は、第5図に示すように、モータ28を構成するロータ52の略中央部にその軸線方向に貫通し且つ中間部位が膨径する通路82を設け、当該通路82内にポンプ本体84を設けている。前記ポンプ本体84は前記通路82の膨径部に配設される複数枚の羽根部材86を含み、前記羽根部材86は当該通路82の中心部に指向している。なお、その先端部は軸88に取着され且つこの羽根部材86は前記通路82の軸線方向に対して若干傾斜してロータ52に取着されている。

このように構成することで前記モータ28の駆動作用下にロータ52を所定方向に回転させると、管体19から送給された患者12の血液は前記羽根部材86により患者12へと送給されることになる。しかも、この実施態様に係る流体移送ポンプ80を構成する固定子ユニット32の固定子枠体36a、36bが前述した第1の実施態様と同様に分割構造となっているため、当該流体移送ポンプ80を血液の体外循環システム10に組み込んだ際に前記体外循環システム10のチューブ14、16を患者

に装着する作業を容易に行うことが出来る。

〔発明の効果〕

以上のように、本発明によれば、ポンプ本体と回転駆動源とが一体的に構成され且つ前記回転駆動源内に流体用通路が形成される流体移送ポンプであって、前記回転駆動源の固定子を少なくとも2以上の分離構造とし、当該固定子を前記回転駆動源の回転子並びにポンプ本体から容易に取り外せるよう構成している。このため、当該流体移送用ポンプを含む流体回路を組み立てる際に前記回転駆動源の固定子を取り外した状態で作業を行うことが出来る。従って、当該流体移送ポンプを相当に軽量化した状態で組立作業自体を遂行出来、結局、この種の作業等を容易且つ確実に行うことが可能となる利点が得られる。しかも、前記固定子に対応して組み付けられる電機子並びに回転速度検出回路等が故障した場合、前記流体回路から当該流体移送ポンプ全体を取り外す必要がなく、固定子のみを取り外して前記電機子並びに回転検出回路等の修理を行うことが出来、この結果、当該流体移送ポンプのメンテナンスが容易となるという効果も得られる。

以上、本発明について好適な実施態様を挙げて説明したが、本発明はこの実施態様に限定されるものではなく、本発明の要旨を逸脱しない範囲において種々の改良並びに設計の変更が可能なことは勿論である。

4. 図面の簡単な説明

第1図は本発明に係る流体移送ポンプを組み込む血液の体外循環システムの概略説明図、

第2図は本発明に係る流体移送ポンプの概略分解斜視図、

第3図は第2図に示す流体移送ポンプの一部省略側面図、

第4図は第2図並びに第3図に示す流体移送ポンプの一部省略断面説明図、

第5図は本発明に係る流体移送ポンプの他の実施態様を示す一部省略断面説明図である。

10…血液体外循環システム
18…流体移送ポンプ　20…サーボアンプ
28…モータ　30…ポンプ本体
32…固定子ユニット　34…回転子ユニット
36a、36b…固定子枠体　44a、44b…電機子
52…ロータ
54…モータマグネット　62…羽根車

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FIG.3

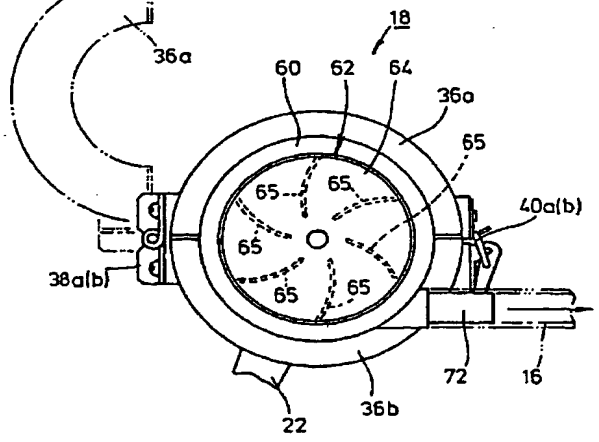


FIG.1

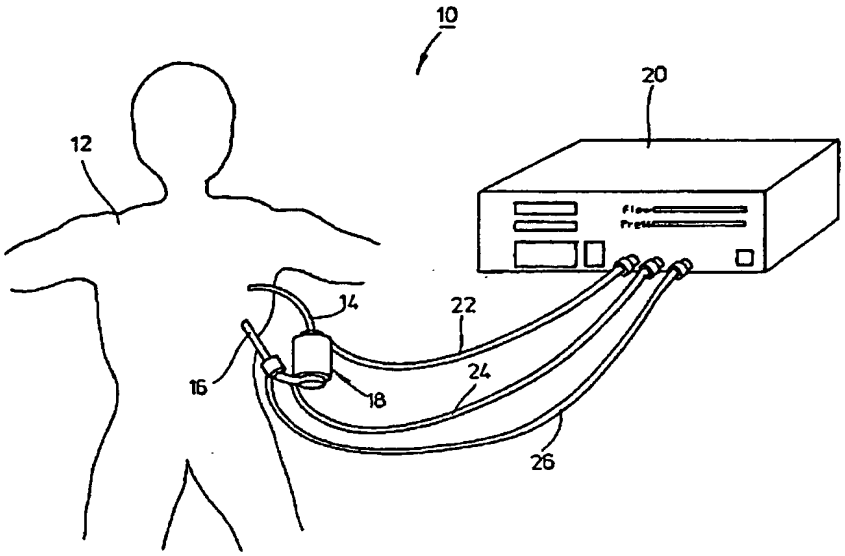

10
12
20
14
22
16
18
24
26

FIG.2

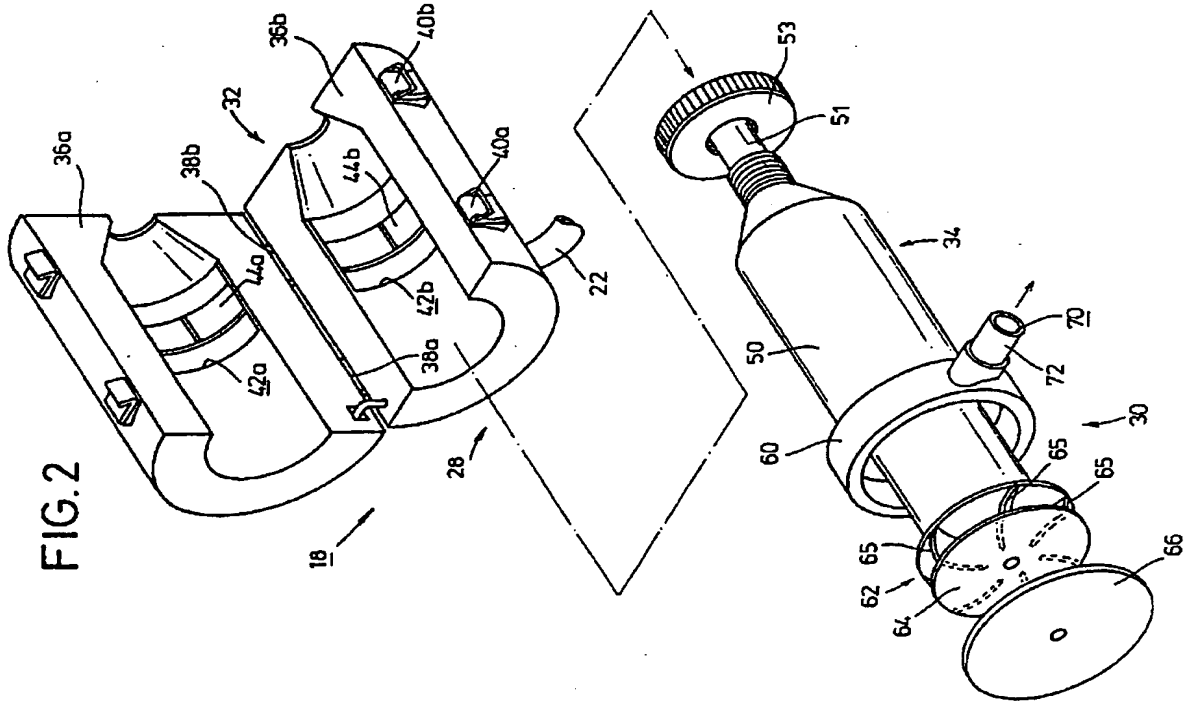

36b
40b
32
36a
38b
44b
40a
44a
42b
22
42a
38a
28
18
53
51
34
70
72
50
30
60
65
65
65
66
62
64

FIG.4

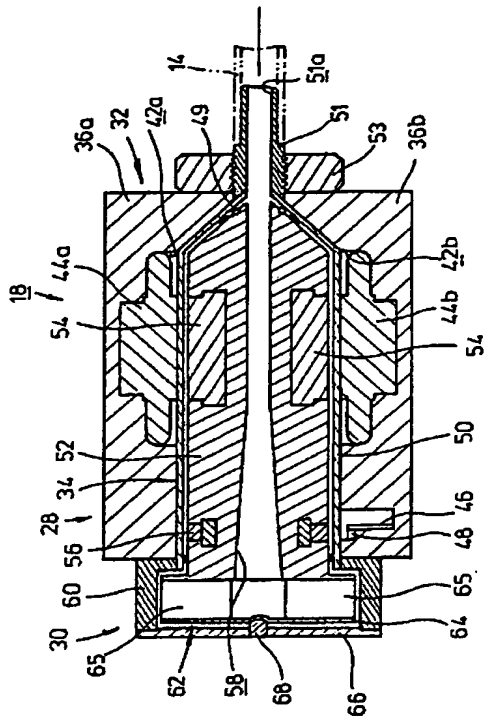
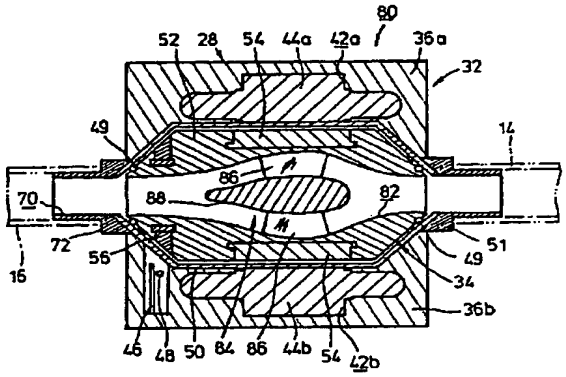

14
7
51a
36a
32
42a
49
51
53
36b
18
44a
42b
54
44b
54
52
50
34
28
46
56
48
60
65
30
64
65
62
58
68
66

FIG.5


80
52
28
54
44a
42a
36a
32
49
14
86
70
88
82
72
56
49
51
16
34
36b
46
48
50
84
86
44b
54
42b